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THE STUDY OF NATURAL SCIENCE

CONSIDERED AS A MEANS OF

INTELLECTUAL CULTURE.

A DISCOURSE

DELIVERED BEFORE

THE YOUNG MEN'S SOCIETY OF LYNCHBURG,

BY PROFESSOR GEO. D. ARMSTRONG,

OF WASHINGTON COLLEGE, VA.

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CORRESPONDENCE.

LYNCHBURG, Nov. 22d, 1840.

Dear Sir :—It devolves upon us to transmit to you the following resolutions which were unanimously adopted by the Young Men's Society, on the evening of the 21st November:

Resolved, That the Rev. George D. Armstrong be and is hereby elected an Honorary Member of this Society.

Resolved, That the thanks of this Society be presented to Mr. Armstrong, for his able and eloquent address, and that a copy for publication be requested.

We take great pleasure in performing the duty assigned us, and hope that you will comply with the wishes of the Society.

We have the honor to be
With respect,
Your obedient servants,
WM. T. YANCEY,
WM. S. REID, Jr.,
RICHARD H. TOLER.

—

WASHINGTON COLLEGE, Dec. 9th, 1840.

Gentlemen :—Your commmunication of November 22d, containing a notice of my election as an honorary member of your Society, and a request that I would furnish a copy of the address I had just delivered before you, for publication, was duly received. Enclosed I send you a copy of my address, which I place at your disposal. Please return my thanks to the Society for the honor they have conferred upon me by electing me an honorary member of their body. Should it ever be in my power to attend their meetings, or in any way to promote their interest, it will afford me great pleasure to do so. Accept my thanks for your own kindness, and believe me,

With sentiments of the highest esteem, yours,
GEO. D. ARMSTRONG.

Messrs. WM. T. YANCEY, WM. S. REID, JR., and R. H. TOLER.

A DISCOURSE.

THE STUDY OF NATURAL SCIENCE CONSIDERED AS A MEANS OF INTELLECTUAL CULTURE.

Gentlemen :—In compliance with your very kind invitation, I appear before you this evening. The subject which I have selected for the present occasion, is *an examination of the claims of Natural Science to a place in the course of our Collegiate Education.* In making such a selection, I have been influenced, in part, by the belief that you would expect from me something connected with that department of instruction, which, in a neighboring institution, has been committed to my charge, and with which you naturally suppose me most familiar ;—and in part, by the reflection, that whilst the benefits which have accrued to mankind from discoveries in Science, in the improvement of manufactures, the arts, and agriculture, and the importance of a thorough acquaintance with Science to those engaged in these pursuits, have been set before you once and again, the claims of the study, to be admitted as a means of intellectual culture, have hitherto remained unnoticed.

The object of education is not, as has sometimes been said, to store the mind of the student with useful knowledge, but to discipline the mind itself; to school the intellectual powers to the correct performance of the labor to which they must be subjected in the world. More especially is this true, in the case of those who are looking forward to a professional career, in which they will be called upon to address their fellow men, either directly, or through the medium of the press. Those of us who have taken part, even for a little time, in the business of "this every-day world of ours," know full well, that it is not the fairy-land which in early youth we have imagined it, but a scene of strife, of turmoil, of ceaseless action :—know full well, that he who would always act aright, and would induce others to do so too, needs a keen eye to discern the truth, and a strong arm to seize upon it and hold it up to public view ; aye, and more than this, he needs an eloquent tongue to persuade his fellow men to receive it as

truth :—know full well, that honour and influence come not unsought, but are like precious pearls, which lie buried beneath the wave, and he who would have them, must dive the ocean, and with his own hands bring them thence.

To afford the student that intellectual training, which will fit him for the business of life, is the great object of Collegiate Education ;—and in order that we may judge of the propriety of using the study of Natural Science for such a purpose, let us examine briefly the nature of that study.

Under the general name of Natural Science, is included all our knowledge of the nature and structure of this world in which we live, and of the phenomena which are continually occurring around us. It is impossible that man should exist, for any great length of time, in such a world as this of ours, surrounded with so much that is curious and beautiful, that is admirable in its structure, and useful in its end, and not begin to inquire, to observe, and to store up the results of his observation. Every thing invites him to such a course. The star that glitters bright in the blue heavens above him ; the frail blossom which opens in beauty at his feet ; the gorgeous rainbow, appearing for a few moments upon the bosom of the storm-cloud, and then vanishing away ; the shining dew-drop ; the chrystal, more perfect in its form than the choicest work of art ; the ever-changing seasons ; the unvarying succession of day and night ; the wondrous magnet ; the lightning ; the loud thunder ; all call upon him for observation,—all would reproach him should he sit down with folded arms, in contented ignorance. From the earliest ages, man has been engaged in the observation of nature, and in storing up the results of his observations—and these results, are the crude material of which Science has been afterwards constructed. Such is the nature of the human mind, that so soon as a number of facts has been collected, the work of comparison commences. We notice that many of these facts are similar in their nature, and we arrange them in accordance with this observed similarity, including such as are thus arranged together, under one general statement. This is the first step in the transformation of a mass of simple observations into Science, properly so called. At the same time that we are struck with that similarity which leads us to generalize our observations, we observe also that some things bear to others the relation of cause to effect ; so that when we observe the one, we un-

hesitatingly infer the existence of the other; and we arrange them in accordance with this observed relation. When this work has been completed, our knowledge has become Science:—for Science is not something essentially different from human knowledge in general, but simply that knowledge arranged and generalized:—or, to borrow an illustration, from that process of nature, in which the particles of a body assume each its own appropriate place, and the body itself a determinate and symmetrical form, Science is human knowledge chrystalized.

Let us inquire then, in what way the mind is exercised in thus accumulating knowledge, and afterwards giving to that knowledge the form of Science—for whatever kind of exercise the mind receives in the creation of Science, in the first instance, it must receive as truly, though not to the same extent, in obtaining a thorough acquaintance with that Science afterwards.

In the collection of facts, an active, inquiring disposition, always alive to gather information, wherever and whenever it may present itself, is requisite; and if it exist, is cherished and strengthened by exercise. The circle of Natural Science embraces air, earth, and sea; and would we perfect it, all must be observed, all must be studied. There is nothing so vast, that we do not seek to comprehend it; there is nothing so insignificant, that we would willingly pass it by unnoticed. To place this necessity for universal observation in its proper light, let me mention the single fact, that many of the most inconsiderable phenomena which meet the eye, are nature's grander operations in miniature; and it is in the study of the former, and there alone, we can learn to explain the latter. It was the fall of an apple which first suggested the existence and true nature of that force which binds the universe together:—It was in the colours of a soap-bubble, as it glistened in the sun, that the mysteries of the rainbow were first fully learned. As truth is single and consistent with itself, a principle may be as fully disclosed by the most simple fact, as by the most imposing phenomenon. Hence is it, that "from the least of nature's works, man often learns the greatest lesson." In such a field as this, presenting a vast variety of objects, curious and beautiful in themselves, if any where, an active, inquiring disposition of mind, can be brought to perfection. It is related of the celebrated Naturalist, Linnæus, that on one occasion, during a lonely journey through a portion of Siberia, he became exhausted with travel,

and in despair laid himself down upon a rock to sleep, even though he feared, from the nature of the climate, that his sleep would prove the sleep of death. Just as he was closing his eyes, he casually noticed a little plant, growing upon the face of the rock, which seemed to have scooped out for itself a cavity in which its roots had spread :—on looking a little further, he saw that this was not a solitary instance, but that many others, of the same kind of plant, and in similar circumstances, were scattered over the surface of the rocks around him. His interest was at once excited, and with all the ardor of a Naturalist, starting up, he commenced an examination of this curious phenomenon.—His weariness was all forgotten; and after having satisfied himself respecting the manner in which these cavities had been formed by the plants, in his own words, he "pursued his journey with almost the freshness of the morning." How strong must have been that disposition of mind, which could thus overcome a mortal drowsiness; could infuse new life into the limbs of one, who had laid himself down to die?

In the arrangement and generalization of our knowledge, the mind is disciplined to continuous attention, to careful and minute examination, and the memory is exercised in the best possible manner. The objects and phenomena, which, in consequence of their similarity, are to be classed together, do not present themselves all at once, nor are they all to be observed in any one particular spot. The arrangements of nature are as far as possible from being scientific in their character. On the Philosopher devolves the labour of bringing together from far distant lands the individuals constituting each several class. Would we become acquainted, for instance, with all the plants belonging to any one natural family, we must search for them in every country, even in the far-off islands of the sea.—Or would we study, for instance, the class of electrical phenomena; a part of them can be best studied in the alternate approach and retrocession of the feather brought near to an excited piece of sealing-wax; others in the quick-flashing lightning; others again, in the turning of the well-poised needle to the pole; and yet others, in the mysterious action of galvanic arrangements :—And all these must be closely observed, and carefully studied, before our classification can be complete, or our generalization such as may be depended upon. It is worthy of remark, that much of the classification in some departments

of Natural Science, is founded upon analogies, which would never have occurred to the casual observer; and which nothing but close and minute examination could ever have brought to light. Before the labours of the Chemist had detected their similarity in composition, who would have thought of placing the diamond, the hardest and most brilliant of all gems, and common charcoal,, in the same class? Or the costly sapphire, and the clay which we tread beneath our feet, in immediate juxtaposition, as objects most closely resembling each other? Or, before Franklin had demonstrated their identity, who would have considered the sparkling of a cat's back when rubbed in the dark, an appearance which amused him when a child, and the lightning of heaven, before which, since a full grown man, he has sometimes trembled, as the operations of the same agent in fact, but developed to a different degree? Where a classification is to be effected of so great a variety of objects, scattered as they are over every part of our globe, and that classification is often dependent upon hidden analogies, as in the instances just mentioned, can it be accomplished without most careful study, and long continued observation? Or after it has been effected, can it be fully comprehended without similar exertion on the part of the student?

I have remarked, that in thus classifying objects, and generalizing our observations, *the memory is disciplined in the best possible manner.* All must have noticed the fact, that in different persons, the memory is exerted in very different ways. Some persons remember individual facts, as individual facts, without any reference whatever to their relation to other facts. The memories of such persons may be styled simply retentive memories. Their stores, though they may be extensive, embracing a vast amount of information on a great variety of subjects, yet are they always heterogeneous in their character, without order and without arrangement. Others remember facts entirely in consequence of their relation to other facts. The memories of such may be styled philosophical memories. Their stores, so soon as received, are arranged in proper order: and it matters not how extensive nor how various they may be, each individual fact has and keeps its own proper place. Place two persons, differing thus in their habits of memory, in the same circumstances, and give to each the same amount of information; and the one of philosophical habits, the one accustomed to the connection of facts in accordance

... observed analogies, will possess an incalculable advantage over the other. Have you never noticed the power which some persons possess, of laying all nature and all history under contribution for the illustration of a subject, or for the support of a position; and after having listened to their argument, on reviewing that which you have heard, have you never noted the fact, that nothing has been advanced with which you were not already acquainted? The secret of their power lies in this, that having connected facts in their mind, in accordance with observed analogies, all their knowledge was perfectly at command. Philosophical habits of memory are those which we should chiefly endeavor to cultivate in youth; for if we would estimate aright the value of the stores of any memory, we must estimate them, not according to the mere amount of information, but the amount of available information, which they embrace. Such are the habits of memory which the study of Natural Science is calculated to foster; in the first place, by fixing the attention upon the analogies which exist between differents things; and afterwards, by accustoming us to arrange them in accordance with a system of classification, based entirely upon these analogies.

In the arrangement of facts in accordance with their observed relations of cause and effect, the mind is exercised not only to minute observation and continuous attention, but to a weighing of probabilities, to the examination of a question in all its elements and in all its relations. Without entering into an examination of the nature of this relation of cause and effect, it will be sufficient for my present purpose to remark, that it is a relation often very difficult of determination; and in evidence of this difficulty, to refer to the fact, that of many of those effects which have been observed from year to year, and from age to age, man has never yet been able to determine the causes. The mere fact, that one event has followed closely upon another, several times in succession, is not sufficient to establish between them the relation of cause and effect. It is often the case, that so far as apparent sequence is concerned, an effect may have sprung from any one of several causes, or a cause may have given rise to any one of several different effects. In such circumstances, we are of necessity liable to error in attempting to determine this relation. In those instances in which it has been clearly established, we are presented with some of the most perfect specimens of philosophical reasoning, any where to

be met with in the whole circle of human knowledge. As instances in point, I may mention the deposition of dew, referred to the cooling of the earth's surface by radiation as its cause—the mercury in the barometer, standing at a height, varying at different times and in different situations, referred to the pressure of the atmosphere as its cause. Time will not permit me to go into a particular examination of these instances; suffice it to remark, that in the settlement of such cases, the mind is of necessity exercised in the examination of a question, in all its elements and in all its relations. For affording such exercise, Natural Science possesses an advantage over the Mathematics in this, that the questions to be determined are to be determined in part by probabilities, and thus more closely resemble the questions we are called upon to determine in the common business of the world.—And at the same time, it possesses an advantage over the less exact Sciences in this, that we can never go very far astray, without having some stubborn fact start up before us, in our path, and forbid our further progress.

An active, inquiring disposition of mind, always alive to the observation of facts, wherever and whenever they may present themselves, habits of minute examination, continuous attention, and correct association, always leading us to connect facts in accordance with their relations, and the manner in which they tend to illustrate each other;—a judgment accustomed to the weighing of probabilities, to the examination of a question in all its elements and in all its relations, are, if I mistake not, among the most important characteristics of a well disciplined mind.

But to drop the argument from the nature of Natural Science, and to refer to facts. Should we search the pages of history, where will we find recorded the name of one, who has exerted a greater influence over his fellow men by his intellect alone—one who has done more for the advancement of mankind in true knowledge—one to whom we can with greater propriety apply the title of "an accomplished scholar," than the father of our modern Philosophy, Francis Bacon, Lord Verulam? Well has he won the honorable title which has been awarded him, of "the high priest of nature's mysteries." The mind of Bacon received its discipline in the study of Natural Science. It was in this study he first became acquainted with the principles of the inductive philosophy—and in

his Novum Organum, his great work, in which he develops the principles of that philosophy, it is from nature he draws his facts, to illustrate and enforce those principles. It was here he acquired that strength which enabled him to overthrow the false philosophy of his age, and in its stead to rear from the dust a more enduring philosophy, one which shall be his glorious monument to the latest generation. Or, to go still further back, who of the learned men of antiquity stands more prominently forth, as one possessed of a great mind, trained to the accomplishment of great things, than Aristotle? More than 1500 years after his death, the rule of "the great enchanter of Stagyra" extended over the whole civilized world. In the words of Lord Brougham, "Christians, Jews and Mohamedans united in professing assent to the great law-giver of human opinions—not Europe alone, but Asia and Africa acknowledged his dominion—and whilst his Greek originals were studied in Paris, translations were read in Persia and at Samarcand. And when the Council of Lateran, under Pope Innocent III, prohibited the use of his 'Physics and Metaphysics,' awful as were the thunders of the Vatican, they were not mighty enough to dethrone him from that despotism over men's minds, which had now rendered itself almost omnipotent." It is true, that the influence which Aristotle exerted was not, throughout, a happy influence; but in justice to him, we should remark, that this was owing not so much to defects in his philosophy, though that philosophy had many and great defects, as to the fact, that in the pursuit of knowledge, he attained a point so far in advance of his age, that men looked up to him with blind reverence, as one who had reached the *ultima thule* of human knowledge. The mind of Aristotle was trained in the study of Natural Science.—It was here that he acquired those habits, which enabled him to wield an influence so extensive and so lasting over the opinions of his fellow men. It surely is not necessary that I should mention other instances than these, to establish the claim of Natural Science to a place, and an important place, in every course of intellectual training.

But to the accomplished scholar, whether he purpose to address his fellow men directly, or through the medium of the press, something more is necessary than a mind well disciplined to discern the truth—he needs an eloquent tongue to persuade those whom he addresses to receive it as truth. For all practical purpo-

ses, he might almost as well be ignorant of the truth, as unable to give it appropriate utterance. Vivid conceptions, noble sentiments, and glowing thoughts, confined to the bosom in which they have originated, are comparatively of little worth. The scholar should be able to express himself in appropriate and well chosen language, to present the truth in its most attractive form. In the accomplishment of this work, the fancy can render him important aid—not that it can ever supply the place of the reasoning powers—not that fine imagery can ever compensate for the lack of valuable thought and correct reasoning. The proper office of the fancy, is to embellish and adorn the truth. The mind of the scholar, be he an author or a public speaker, should be kept steadily fixed upon the truth which he intends to communicate, or the impression which he desires to produce; and nothing should be suffered to turn him aside, for one moment, from these. But all this may be effected, and yet the fancy have full room for the exercise of its utmost power. The course of his mind should be like that of the rivulet, which, whilst in obedience to the great law of gravity, it quits its mountain home, and with ceaseless motion onward, seeks the broad ocean, yet marks its course with verdure and sweet flowers—or like that of the sunbeam, which, whilst it speeds it on its way to illumine the earth, nor stops in all its course, yet passing, finds time to paint the beauteous rainbow on the clouds.

In the formation of a simple and correct style of expression, the study of Natural Science can afford but little if any assistance: —*but in giving to the scholar a control over much beautiful imagery*, it can render him important service. And this it can effect, not directly, by supplying him imagery from its own stores; for scientific truths, such as are not familiar to all, can never be used with good effect, for purposes of illustration:—but indirectly, by cherishing within him a fondness for nature, quickening his perception of analogies, and giving to him those habits of attention, which will lead him to observe and remember a thousand things in the world around him, which, though they pass before the eyes, will yet entirely escape the notice of another. To the eye of one disciplined to careful observation, all nature appears strewed with gems of knowledge, thick and bright as the glistening drops of early dew. If you will turn to the works of our most accomplished writers, you will be surprised to see how large a p. tion of

their most beautiful imagery is drawn from the natural world.—Let me mention an instance or two.

"Therefore to be possessed with double pomp,
T' enrich a title that was rich before,
To gild refined gold, to paint the lily,
To throw a perfume on the violet,
To smooth the ice, or add another hue
Unto the rainbow, or with taper-light
To seek the beauteous eye of Heaven to garnish,
Is wasteful and ridiculous excess."—*Shaks.*

Again:

"But pleasures are like poppies spread,
You seize the flower, its bloom is shed;
Or like the snow-falls in the river,
A moment white, then melts forever;
Or like the Borealis race,
That flit ere you can point their place;
Or like the rainbow's lovely form,
Evanishing amid the storm."—*Burns.*

Again: "As the vine which has long twined its graceful foliage about the oak, and been lifted by it into the sunshine, will, when the hardy plant is rifted by the thunderbolt, cling round it with its caressing tendrils, and bind up its shattered boughs; so is it beautifully ordered by Providence, that woman, who is the dependent and ornament of man in his happier hours, should be his stay and solace when smitten with sudden calamity, winding herself into the rugged recesses of his nature, tenderly supporting the drooping head, and binding up the broken heart."—*W. Irving.*

Again: "It would have been well for him could he have forgotten the past, that he might not so mournfully have lived in it, but might have enjoyed and improved the present—But this his heart refused to do; and ever, as he floated upon the great sea of life, he looked down through the transparent waters, checkered with sunshine and shade, into the chambers of the mighty deep, in which his happier days had sunk, and wherein they were lying, still visible, like golden sands, and precious stones, and pearls; and half in despair, half in hope, he grasped down after them again, and drew back his hand, filled only with sea-weed, and dripping with briny tears."—*Prof. Longfellow.*

Thus far, in considering the course which should be pursued in the education of youth, we have confined our attention to that which was calculated to improve the intellect alone.—We must not forget that man is possessed of a moral nature also. If by any

course, the intellect is improved at the expense of moral character, though that intellectual improvement be of the most perfect kind, it will be purchased at far too dear a rate. Intellectual power, in the possession of one devoid of correct moral principle, will prove to its possessor, and to his country too, a curse, and not a blessing. It will be like a sharp sword in the hands of a madman, as likely to pierce friend as foe. In determining upon any course to be pursued in the education of youth, a preference should always be given to such studies as are calculated to give him correct and noble conceptions of the character of Deity, and to foster in his bosom feelings of reverence toward him:—For blot out from the mind all ideas of Deity, and moral principle is at an end:—or degrade man's conceptions of the character of Deity, and to the same extent, do you weaken the sanction with which obedience to moral principle is urged home upon the heart. It has been well remarked by an eminent writer, that "all the branches of learning usually pursued by youth, are but the knowledge of God's works;—philosophical and mathematical learning, the knowledge of his works of Creation;—historical and political learning, the knowledge of his works of Providence;—moral, economical and civil learning, the knowledge of those remainders of his image and law which are left in the minds of men for their direction and conviction;—grammatical, rhetorical and logical learning, the knowledge of the use of that reason which God gives us for imparting our minds and evidencing our conceptions to one another;" *(Bishop Reynolds,)*—and of course all of them, if pursued to their full extent, and in a truly philosophical spirit, are calculated to cherish in the bosom proper feelings of reverence toward the Deity, and to give us noble conceptions of his character. But whilst, in general, this is true of all, some are more eminently calculated to produce such an effect than others; and in the foremost rank, in this respect, stands the study of Natural Science.—It is in the contemplation of Nature, that the power and excellency of Deity are most deeply impressed upon the mind. How often have the feelings, which have thus been awakened, found utterance in such language as this:—"O Lord, how excellent is thy name in all the earth! who hast set thy glory above the Heavens.—When I consider the Heavens, the work of thy fingers, the moon and the stars which thou hast ordained; what is man, that thou

art mindful of him? or the son of man, that thou visitest him?"—"I will praise thee, for I am fearfully and wonderfully made;—marvellous are thy works, and that my soul knoweth right well." Such is the impression produced by the simple contemplation of nature, as it appears to the eye of one unacquainted with Science. But when you bring Science to the aid of human vision, and show the observer, that "the moon and the stars, which God has ordained," are not mere points of light, scattered o'er the azure vault of heaven for its garniture, but are worlds, and centres of systems of worlds, with how much deeper feeling will he exclaim, "What is man, that thou art mindful of him? or the son of man, that thou visitest him?"—Or, turning to the examination of the human body, you point him to the rude and unsightly materials out of which divine wisdom has constructed this wondrous fabric, and bid him consider the curious mechanism of the eye, the ear, the tongue, the heart, the limbs, each perfect in its kind, sensible to the most delicate impressions of external objects, and even giving involuntary utterance to the passions and emotions of the immaterial thinking spirit; with how much deeper feeling will he exclaim, "I am fearfully and wonderfully made:"—Or, fixing his attention upon the contemplation of this world which we inhabit, you point him to the record of a long series of changes which it has undergone; not written upon parchment, which might be lost; nor handed down by tradition, which might be perverted; but "written as with a pen of iron, in the rock, forever;" and in imagination carry him back through unmeasured cycles of existence, and shew him, that before all this, even "in the beginning, God created the heavens and the earth;" it is then that he can best conceive of the eternity of God's existence:—Or pointing him to this same earth, rent and torn by what appear to us ungovernable forces, and yet by these very means moulded to the purposes of Deity, "as clay in the hands of the potter," it is then, that he can best conceive of the infinity of God's power—It is then, that with deepest feeling he can exclaim, "O Lord, how excellent is thy name in all the earth! who hast set thy glory above the Heavens." "Marvellous are thy works, and that my soul knoweth right well."

Thus, gentlemen, have I endeavored to set before you the claims of Natural Science, to be regarded as a most important means of intellectual culture. If I have erred in investing the

subject with unreal importance, my arguments are now before you; and with you do I leave it, to reduce my estimates to the dimensions of truth.